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November 16, 2005

Gordon Helm, Chief
Marine Mammal Division
Office of Protected Resources
National Marine Fisheries Service
1315 East - West Highway
Silver Spring, MD 20910-3226

Subject: Request for Approval, Incidental Harassment Authorization for Non-Lethal Taking of Whales and Seals in the Mid and Eastern Beaufort Sea, Alaska During 2006

Dear Mr. Helm:

Shell Offshore, Inc. (Shell) and its geophysical (seismic) contractor WesternGeco propose to conduct a marine geophysical (deep seismic) survey program during open-water season on various U.S. Minerals Management Service (MMS) Outer Continental Shelf (OCS) lease blocks in the Mid and Eastern Beaufort Sea. Shell and WesternGeco request an Incidental Harassment Authorization (IHA) pursuant to Section 101 (a) (5) (D) of the Marine Mammal Protection Act (MMPA), 16 U.S.C. § 1371 (a) (5), to allow non-lethal takes of whales and seals incidental to offshore geophysical seismic operations.

The only type of incidental taking sought in this application is takes by noise harassment stemming from WesternGeco's deep seismic survey vessel M/V Gilavar, the M/V Alex Gordon, and the as yet unidentified vessels to be used for site clearance and shallow hazards, and geotechnical coring.

The M/V Alex Gordon will serve as a resupply, fueling and chase vessel and is capable of assisting in ice management operations but will not deploy seismic acquisition gear. Shell has not yet selected the contractors and their vessels to perform site clearance, shallow hazards survey work, and geotechnical coring. The contractors and their vessels will be known shortly and National Marine Fisheries Service (NMFS) will be notified of this well before commencement of activities.

The proposed Beaufort Sea deep seismic, site clearance, shallow hazard surveys and geotechnical activities will commence in August and continue into October 2006. The timing is scheduled to avoid conflict with the Beaufort Sea subsistence hunt conducted by the Alaska Eskimo Whaling Commission's (AEWC) villages. Shell is presently negotiating the provisions of a Conflict Avoidance Agreement with the AEWC regarding times and areas to avoid any possible conflict with the bowhead subsistence whale hunts by Barrow, Kaktovik and Nuiqsut. Shell has participated in early consultation and coordination with Native entities that conduct subsistence activities in the area and conveyed a strong desire for avoiding potential conflicts.

Any impacts on the whale and seal populations of the Beaufort Sea seismic activity are likely to be short term and transitory in temporary displacement of individuals or small groups that may be exposed to seismic sounds at the 160-190 decibels received levels. The seismic activities will not result in any permanent impact on habitats used by marine mammals or their prey sources. There should be no adverse impacts on the availability of the whale species for subsistence users.

Items presented pursuant to 50 C.F.R. § 216.104, "Submission of Requests", and § 216.107, "Incidental Harassment Authorization for Arctic Waters", are attached with the application and Marine Mammal Monitoring and Mitigation Measures Plan.

Please contact me at 985-543-1248 or Kent Satterlee at 985-902-5228 for further information.

Sincerely,

Philip B. Smith
Manager, Regulatory Affairs and Incident Command

Attachments

cc: w/attachments

Maggie Ahmaogak, Alaska Eskimo Whaling Commission - Barrow, AK
Jessica LeFevre, Alaska Eskimo Whaling Commission – Washington, D.C.
Rance Wall, MMS Alaska Region
Doug DeMaster, NOAA Fisheries - Seattle, WA
Ken Hollingshead, NOAA Fisheries - Silver Spring, MD
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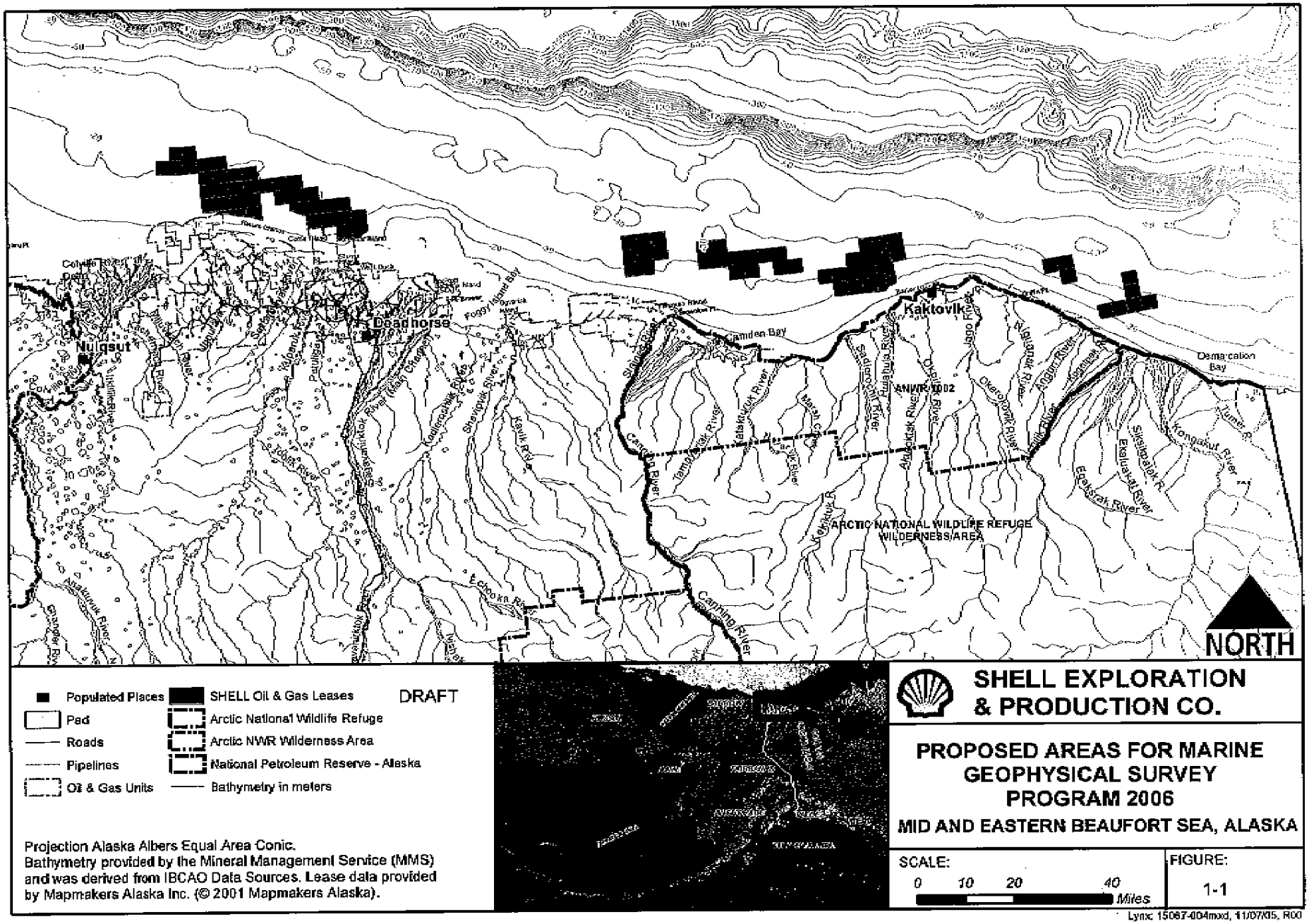

Application for Incidental Harassment Authorization for the Non-Lethal Taking of Whales and Seals in Conjunction with a Proposed Marine Geophysical (Seismic Acquisition) Survey Program in the Mid and Eastern Beaufort Sea, Alaska, During 2006

Submitted by Shell Offshore, Inc. and WesternGeco

November 2005

Shell Offshore, Inc. and WesternGeco used the following guidance to prepare its request for Incidental Harassment Authorization (IHA).

> 50 CFR 216.104 "Submission of Requests"
>
> (a) In order for the National Marine Fisheries Service (NMFS) to consider authorizing the taking by U.S. citizens of small numbers of marine mammals incidental to a specified activity (other than commercial fishing), or to make a finding that incidental take is unlikely to occur, a written request must be submitted to the Assistant Administrator. All requests must include the following information for their activity:

1. A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals:

Information required by 50 CFR§2116.104 (a):

Shell Offshore Inc. (Shell) and its geophysical (seismic) contractor, WesternGeco, propose to conduct a marine geophysical program, including deep seismic, site clearance and shallow hazard surveys on oil and gas leases it owns located on Outer Continental Shelf (OCS) waters in the mid and eastern Beaufort Sea (see Figure 1-1). A geotechnical firm yet to be named under contract to Shell will conduct a marine program of geotechnical data acquisition, including seabed sampling, soil borings and cone penetrometer tests in the same area of OCS oil and gas leases during 2006.

The deep seismic survey component of the program will be conducted from WesternGeco's vessel M/V Gilavar. Detailed specifications of this purpose-built seismic survey vessel are provided in Attachment A – Seismic Survey, Overview/Description. These specifications include: (1) complete descriptions of the number and lengths of the streamers which form the air gun and hydrophone arrays; (2) airgun size and sound propagation properties which need to be known in order to estimate the number of takes by noise harassment of bowhead whales and other marine mammals which may occur within ensonified zones (see Section 6 of this application); and (3) additional detailed data on the M/V Gilavar's characteristics and capacities

as a vessel. The seismic acquisition vessel will be supported by the M/V Alex Gordon, which will serve to resupply and re-fuel the M/V Gilavar. The M/V Alex Gordon is also capable of ice management should that be required. The M/V Alex Gordon will not deploy seismic acquisition gear and its only contribution to the shallow water marine noise field will come from the operation of the vessel. The M/V Gilavar and M/V Alex Gordon vessels will operate in accordance with the provisions of a Conflict Avoidance Agreement (CAA) being negotiated with the Alaska Eskimo Whaling Commission (AEWC) regarding times and areas in order to avoid any possible conflict with the bowhead subsistence whale hunts by Kaktovik and Nuiqsut. Specifications and operating characteristics of the M/V Alex Gordon also are provided as an appendix in Attachment A.

Site clearance and shallow hazards surveys of potential exploratory drilling locations within Shell's lease areas are required by U.S. Minerals Management Service (MMS) regulations. The site clearance surveys are confined to very small specific areas within defined OCS blocks. Shell is currently in the process of selecting site clearance/shallow hazards and geotechnical contractors and vessels for the site clearance/shallow hazards surveys, and geotechnical borings. As yet unidentified vessels will conduct these surveys contemporaneously with the deep seismic survey program. Very small and limited geophysical survey energy sources (see Attachment B – Site Clearance Surveys, Overview/Description) will be employed to measure bathymetry, topography, geohazards and other seabed characteristics. The actual locations of site clearance and shallow hazard have not been definitively set as of this date. That information will be supplied to NMFS and MMS as it becomes available, but well before the commencement of operations. The as yet unidentified vessels conducting the site clearance and shallow hazard surveys, and geotechnical borings will also operate in accordance with the provisions of the Conflict Avoidance Agreement (CAA) regarding times and areas in order to avoid any possible conflict with the bowhead subsistence whale hunts by Kaktovik and Nuiqsut.

2. The dates and duration of such activity and the specific geographic region where it will occur:

The proposed deep seismic survey to be conducted from the M/V Gilavar will occur from early August into October 2006. The exact timing of the commencement date will be dependent on when sea ice conditions allow the vessel to transit to the mid and eastern Beaufort Sea from the Chukchi Sea The M/V Gilavar will be conducting a deep seismic survey in the Chukchi from mid-June through July 2006, and in a second phase from early October through November 2006. Shell and WesternGeco are applying for a separate IHA from NMFS for the Chukchi program. The site clearance and shallow hazards component of the Beaufort program to be conducted from an as yet unidentified vessel will occur during an August through September 2006 timeframe. By early October the M/V Gilavar and M/V Alex Gordon will transit back to the Chukchi Sea.

The geographic region where this work will be performed lies over Shell oil and gas lease-holdings in the mid and eastern Beaufort Sea (See Figure 1-1). All active seismic surveying will occur in federal OCS waters.

The process of geotechnical borings (seabed sampling, soil borings, and cone penetrometer tests) will occur simultaneously with the site clearance/shallow hazards surveys in OCS waters.

3. Species and numbers of marine mammals in area:

The species and numbers of marine mammals likely to be found within the Eastern Beaufort Sea activity areas are listed in Table 4-1.

A total of three cetacean species (bowhead, gray, and beluga whale), three species of pinnipeds (ringed, spotted, and bearded seal), and one marine carnivore (polar bear) are known to occur in or near the proposed study area. Other extralimital species that occasionally occur in very small numbers in the eastern portion of the Alaskan Beaufort Sea include the harbor porpoise and killer whale, however, because of the rarity of the latter species in the eastern part of the Beaufort Sea, they are not expected to be exposed to or affected by any activities associated with the areas of proposed seismic work, and are not discussed further. Only the bowhead whale is listed as "Endangered" under the Endangered Species Act (ESA). Other ESA-listed species which are known to occur in the adjacent Bering Sea include Steller sea lion, sperm whale, humpback whale, fin whale, blue whale, and northern right whale, however, these species are considered to be extralimital in the Chukchi and Beaufort Seas. Due to the very remote chance of interaction or potential impact, these species are not discussed further under this IHA application.

In an effort to reduce redundancy, we have included the required information about these species and abundance estimations (to the extent known) of these species in Section 4 below.

4. Status, distribution and seasonal distribution of affected species or stocks of marine mammals:

The following six species of cetaceans and seals can be expected to occur in the region of the proposed seismic activity: bowhead, gray and beluga whales, and ringed, spotted and bearded seals. These six species are the species for which general regulations governing potential incidental takes of small numbers of marine mammals are sought. The geographic boundaries and distribution, primary habitats, and population trends and risks are discussed under each species.

Three species of marine mammals—the Pacific walrus, sea otter, and polar bear—are managed by the U.S. Fish and Wildlife Service (USFWS). Within the project activity areas in the Eastern Beaufort Sea, only the polar bear is known to occur in significant numbers and potential incidental take of this species will be dealt with under a separate application for a Letter of Authorization from the USFWS; however, general status information on polar bear is included in Table 4-1 but not discussed further under the species discussions.

Table 4-1. List of species that may be encountered during seismic operations within the Beaufort Sea, their habitats, conservation status, and estimated abundance numbers.

Species (Stock)	Habitat	Beaufort Sea Stock and/or ESA Status [1]	Estimated Abundance [2]
Cetaceans			
bowhead whale (*Balaena mysticetus*) (Western Arctic stock)	Pack ice and coastal	ESA listed as Endangered, listed as depleted under MMPA, and classified as a strategic stock	10,545
gray whale (*Eschrichtius robustus*) (eastern north Pacific)	Coastal, lagoons	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	18,813
beluga whale (*Delphinapterus leucas*) (Beaufort Sea/eastern Chukchi Sea)	Offshore, coastal, ice edges	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	39,258/3,710
Pinnipeds			
ringed seal (*Phoca hispida*) (Alaska)	Landfast and pack ice	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	Up to 3.6 million; Currently, no reliable abundance estimate is available for the Beaufort Sea, however, combined with surveys from the Chukchi Sea, approximately 249,000 are estimated.
spotted seal (*Phoca largha*)	Pack ice	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	Several thousand and several tens of thousands. An estimate with correction using 1992 data =59,214 seals but is preliminary at best.
bearded seal (*Erignathus barbatus*)	Pack ice	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	Currently, no reliable abundance estimate is available for this stock. Early estimates of the Bering-Chukchi Seas ranged from 250,000 to 300,000.
Carnivora			
polar bear (*Ursus maritimus*)	Coastal, ice	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	Population estimates for the Southern Beaufort Sea population of northern Alaska is 2,272 bears.

1. ESA = Endangered Species Act. Stocks listed as depleted under the MMPA (Marine Mammal Protection Act) is described as any stock that falls below its optimum sustainable population (OSP) must be classified as "depleted," 16 U.S.C. § 1362(1)(A). The numeric threshold for OSP has been interpreted by NMFS and USFWS as being above 0.6 K (i.e. greater than 60 percent of K, or carrying capacity). In other words, a stock that dropped in numbers to below 60 percent of K would qualify as "depleted" under the MMPA. The term "strategic stock" is defined as a marine mammal stock: (A) for which the level of direct human-caused mortality exceeds the Potential Biological Removal level; (B) which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA of 1973 . . . within the foreseeable future; or (C) which is listed as a threatened species or endangered species under the ESA of 1973 . . ., or is designated as depleted under [the MMPA].
2. See text under individual species for population estimate sources.

Bowhead Whale (*Balaena mysticetus*)

The Western Arctic stock (discussed below) is distributed in seasonally ice-covered waters of the Arctic and near-arctic, generally between 60 and 75 degrees N latitudes in the western Arctic Basin (Moore and Reeves 1993). Currently, five bowhead whale stocks are recognized by the International Whaling Commission (IWC 1992). Small stocks occur in the Canadian Arctic and West Greenland (Baffin Bay, Davis Strait, and Hudson Bay), the Okhotsk Sea (eastern Russia), and the Northeast Atlantic from Spitzbergen westward to eastern Greenland (Zeh et al. 1993). The largest population is the Western Arctic stock, also know as the Bering, Chukchi, and Beaufort Sea stock (Rugh et al. 2003), and is the focus of this IHA.

In Alaskan waters, the majority of bowhead whales winter in the central and northwestern Bering Sea (November to March), migrate through the Chukchi Sea in the spring (March through June) following offshore ice leads around the coast of Alaska, and summer in the Canadian Beaufort Sea (mid-May through September) (Braham et al. 1980; Moore and Reeves 1993).

Bowheads tend to migrate west in deeper water (farther offshore) during years with higher-than average ice coverage than in years with less ice (Moore 2000). During fall migration, most bowheads migrate west in water ranging from 15 to 200 m deep (Miller et al. 2002 *in* Richardson and Thomson 2002); some individuals enter shallower water, particularly in light ice years, but very few whales are ever seen shoreward of the barrier islands.

Bowhead whales typically reach the Barrow area during their westward migration from the feeding grounds in the Canadian Beaufort Sea in mid-September to late-October. Although, over the years, local residents report having seen a small number of bowhead whales feeding off Barrow or in the pack-ice off Barrow during the summer, indicating that this area may be an important feeding area. Autumn bowhead whaling near Barrow normally begins in mid-September, but may begin as early as August if whales are observed and ice conditions are favorable (USDI/BLM 2005). Whaling can continue into October, depending on the quota and conditions.

The pre-exploitation population of bowhead whales in the Bering, Chukchi, and Beaufort seas is estimated to be 10,400 to 23,000 whales, and was reduced by commercial whaling to perhaps 3,000 (Woodby and Botkin 1993). Up to the early 1990s, the population size was believed to be increasing at a rate of about 3.2 percent per year (Zeh et al. 1996; Angliss and Lodge 2002) despite annual subsistence harvests of 14 to 74 bowheads from 1973 to 1997 (Suydam et al. 1995) and 42, 35, 49, 37, and 35 in 1999 through 2003, respectively (Suydam and George 2004). This is consistent with an annual population growth rate of 3.4 percent (95 percent CL 1.7-5 percent) from 1978 to 2001 reported by George et al. (2004) who estimated the population in 2001 at approximately 10,470 animals. Based on the most recent abundance estimates using 2001 data, approximately 10,545 bowheads whales make up the Western Arctic stock, with a minimum estimate [coefficient of variation [CV](N) = 0.128] of 9,472 whales (Angliss and Outlaw 2005).

The inclusion of the abundance estimate for 2001 results in a rate of increase of 3.5 percent (confidence intervals [CI] = 2.2 to 4.9 percent) (Brandon and Wade 2004 *cited in* Angliss and Outlaw 2005). Calve counts in 2001 was the highest recorded at 121 individuals, and lends building evidence of a growing population.

This bowhead population is currently listed as Endangered under the ESA and is classified as a strategic stock by NMFS (Angliss and Outlaw 2005).

Gray Whale (*Eschrichtius robustus*)

Gray whales originally inhabited both the North Atlantic and North Pacific oceans. The Atlantic populations are believed to have become extinct by the early 1700s, while a relic population survives in the western North Pacific. The eastern North Pacific or California gray whale population has recovered significantly from commercial whaling, and now numbers about 18,813, and this stock is the focus for this IHA (Angliss and Outlaw 2005).

The eastern North Pacific population of the gray whale ranges from the Bering, Chukchi, and Beaufort Seas (in summer) to the Gulf of California (in winter) (Rice 1998). Gray whales have also been documented foraging during summer in waters off of Southeast Alaska, British Columbia, Washington, Oregon, and California (Rice and Wolman 1971; Berzin 1984; Darling 1984; Quan 2000; Calambokidis et al. 2002). Most of the eastern North Pacific population migrates annually from Alaska waters to Baja California in Mexico, more than 8,000 km (5,000 miles) roundtrip. From late May to early October, the majority of the population concentrates in the northern and western Bering Sea and the Chukchi Sea.

Gray whales are found primarily in shallow water, and usually remain closer to shore than any other large cetacean. Gray whales are considered common in the nearshore waters of the eastern Chukchi Sea, and occasionally are seen east of Point Barrow in late-spring and summer. On wintering grounds, mainly along the west coast of Baja California, gray whales utilize shallow, nearly land-locked lagoons and bays (Rice et al. 1981). From late February to June, the population migrates back to arctic and subarctic seas (Rice and Wolman 1971).

Most summering gray whales congregate in the northern Bering Sea, particularly off St. Lawrence Island and in the Chirikov Basin (Moore et al. 2000), and in the southern Chukchi Sea. More recently, Moore et al. (2003) suggested that gray whale use of Chirikov Basin was reduced, likely as a result of the combined effects of changing currents resulting in altered secondary productivity dominated by lower quality food. The northeastern-most of the recurring feeding areas is in the northeastern Chukchi Sea southwest of Barrow (Clarke et al. 1989).

A small number gray whales has been observed entering the Beaufort Sea east of Point Barrow. Maher (1960) reported hunters at Cross Island took one gray whale in 1933. Aerial surveys conducted in the central Alaskan Beaufort Sea documented only one gray whale between 1979 to 1997. Since 1997, small numbers of gray whales have been documented on several occasions in the central Alaskan Beaufort—mainly in the Harrison Bay area (Miller et al. 1999; Treacy 2000, Green et al. 2005, in progress). Other reports of single gray whale sightings have been documented farther east of Harrison Bay (Rugh and Fraker 1981). In August 2001, Williams and Coltrane (2002) reported a single sighting of a gray whale near the Northstar production facility, indicating that small numbers do travel through the waters offshore from the Prudhoe Bay region during some summers, Given their rare occurrence in the eastern portion of the Beaufort Sea in summer, no more than a few are expected during the summer and early fall.

Gray whales have been counted as they migrate southward past Granite Canyon in central California each year since 1967. The most recent abundance estimates are from southbound migration counts in 1997/98, 2000/01, and 2001/02 periods with abundance estimates for the

aforementioned periods of 29,758, 19,448, and 18,178, respectively [Rugh et al. (in press) *in* Angliss and Outlaw 2005].

Previous variations in estimates may be attributed to differences in the proportion of the gray whale stock migrating as far as the central California coast each year. The decline in abundance estimates between the 2000/01, and 2001/02 may be an indication that the abundance was responding to environmental limitations as the population approaches carrying capacity (Angliss and Outlaw 2005). The lower counts conducted in 2000/01 and 2001/02 may have been due to a large number of whales that did not migrate as far south as Granite Canyon, or possibly, abundance may have actually declined following high mortality rates documented in 1999 and 2000 (Rugh et al. (in press) *cited in* Angliss and Outlaw 2005; Gulland et al. 2005).

Using the mean of the 2000/01 and 2001/02 abundance estimates noted above is 18,813 animals (Angliss and Outlaw 2005). Gray whale numbers increased steadily until at least 1998, with an estimated annual growth rate of 3.3 percent between 1967 and 1988 (Buckland et al. 1993). More recent estimated growth rates from 1967/68 through 2001/02 indicate and annual growth rate of 1.9 percent (SE = 0.32 percent) [Rugh et al. (In press) *in* Angliss and Outlaw 2005]. In addition, Rugh et al. (in press) estimated carrying capacity of 26,290 (CV = 0.059), indicating that recent reductions in abundance estimates may be a function of the population reaching its carrying capacity.

The eastern Pacific stock was removed from the Endangered Species List in 1994 and is not considered by NMFS to be a strategic stock.

Beluga Whale (*Delphinapterus leucas*)

The beluga whale is an arctic and subarctic species with several populations (stocks) occurring in Alaska: Beaufort Sea, eastern Chukchi Sea, eastern Bering Sea, Bristol Bay, and Cook Inlet (O'Corry-Crowe et al. 1997, Angliss and Lodge 2004). For the proposed project, only the Beaufort Sea stock and eastern Chukchi Sea stocks will be encountered. Some eastern Chukchi Sea animals enter the Beaufort Sea in late summer (Suydam et al. 2001).

Beluga whales of the Beaufort stock winter in the Bering Sea, summer in the eastern Beaufort Sea, and migrate around western and northern Alaska (Angliss and Lodge 2002). The majority of belugas in the Beaufort stock migrate into the Beaufort Sea in April or May, although some whales may pass Point Barrow as early as late March and as late as July (Braham et al. 1984; Ljungblad et al. 1984; Richardson et al. 1995).

Much of the Beaufort Sea seasonal population enters in the Mackenzie River estuary for a short period during July and August to molt their epidermis, but they spend most of the summer in offshore waters of the eastern Beaufort Sea and Amundsen Gulf (Davis and Evans 1982; Harwood et al. 1996). Belugas are rarely seen in the central Alaskan Beaufort Sea during the summer. During late summer and autumn, most belugas migrate far offshore near the pack ice front (Hazard 1988; Clarke et al. 1993; Miller et al. 1998) and may select deeper slope water independent of ice cover (Moore et al. 2000b). Small numbers of belugas are sometimes observed near the north coast of Alaska during the westward migration in late summer and autumn (Johnson 1979) but the main fall migration corridor of beluga whales is greater than 100 km (62 miles) north of the coast. Aerial- and vessel-based seismic monitoring programs conducted in the central Alaskan Beaufort Sea from 1996 through 2001 observed only a few

beluga whales migrating along or near the coast (LGL and Greeneridge 1996; Miller et al. 1998, 1999). The vast majority of belugas seen during those projects were far offshore. Satellite-linked telemetry data show that some belugas migrate west considerably farther offshore, as far north as 78 degrees N latitude (Richard et al. 1997, 2001).

The Beaufort population was estimated to contain 39,258 individuals as of 1992 (Angliss and Lodge 2002). This estimate is based on the application of a sightability correction factor of 2 times to the 1992 uncorrected census of 19,629 individuals made by Harwood et al. (1996). This estimate was obtained from a partial survey of the known range of the Beaufort population and may be an underestimate of the true population size. This population is not considered by NMFS to be a strategic stock but the current population trend of the Beaufort Sea stock of beluga whales is unknown (Angliss and Outlaw 2005).

The abundance estimate considered the "most reliable" for the eastern Chukchi Sea beluga whale stock is 3,710, a result from 1989–1991 aerial surveys (Frost et al. 1993, Angliss and Lodge 2004). Additional surveys were conducted in 1998 (DeMaster et al. 1998) and again in July 2002 (Lowry and Frost 2002, *cited in* Angliss and Outlaw 2005), but both were partial surveys and therefore, a more recent abundance estimate is not available. This stock will not likely be encountered during the seismic surveys in the eastern Beaufort Sea, the population size is considered stable and not considered to be a strategic stock.

Ringed Seal (*Phoca hispida*)

In the North Pacific, ringed seals are found in the southern Bering Sea and range as far south as the Seas of Okhotsk and Japan. Ringed seals have an affinity for ice-covered waters and are well adapted to occupying seasonal and permanent ice, and are year-round residents throughout the Beaufort, Chukchi, and Bering Seas, as far south as Bristol Bay in years of extensive ice coverage. They tend to prefer large floes (more than 48 m in diameter) and are often found in the interior ice pack where the sea ice coverage is greater than 90 percent (Simpkins et al. 2003), and remain in contact with ice most of the year and pup on the ice in late winter-early spring.

During winter, ringed seals occupy landfast ice and offshore pack ice of the Bering, Chukchi, and Beaufort Seas. Ringed seals maintain breathing holes in the ice and occupy lairs in accumulated snow (Smith and Stirling 1975). They give birth in lairs from mid-March through April, nurse their pups in the lairs for 5–8 weeks, and mate in late-April and May (Smith 1973; Hammill et al. 1991; Lydersen and Hammill 1993).

During late-April through June, ringed seals are distributed throughout their range from the southern ice edge northward (Braham et al. 1984). Preliminary results from recent surveys conducted in the Chukchi Sea in May-June 1999 and 2000 indicate that ringed seal density is higher in nearshore fast and pack ice, and lower in offshore pack ice (Bengtson et al. (in review) *cited in* Angliss and Outlaw 2005). Frost and Lowry (1999) conducted surveys in May and results indicated that, in the Alaskan Beaufort Sea, the density of ringed seals in May-June is greater to the east of Flaxman Island than to the west.

No estimate for the size of the Alaska ringed seal stock is currently available (Angliss and Outlaw 2005). Past ringed seal population estimates in the Bering-Chukchi-Beaufort area ranged from 1 to 3.6 million (Frost et al. 1988). Frost and Lowry (1981) estimated 80,000 ringed seals in the Beaufort Sea during summer and 40,000 during winter.

Aerial surveys within 20 nautical miles (nm) of shore were conducted in May-June between 1986 and 1987 for a portion of the range of the ringed seal estimated 44,360 +/-9,130 (96 percent CI) (Frost et al. 1988). Spring density estimates in the same area from 1985-1987 ranged from 1.01 to 2.94 seals/km^2 (Frost and Lowry 1988). Similar surveys for the Alaska Beaufort Sea between Kaktovik and Barrow occurred in the spring during several years in the 1990s with density estimates for all years ranging from 0.81-1.17 seals/km^2 with a mean of 0.98 seals/km^2 or approximately 18,000 hauled out ringed seals in the survey area. Surveys conducted in 1999 and 2000 between Shishmaref to Barrow in the eastern Chukchi Sea estimated abundance of ringed seals at 252,488 (SE = 47,204) and 208,857 (SE = 25,502), respectively [Bengtson et al. (in review) *cited in* Angliss and Outlaw 2005]. Combining the numbers of Alaska Beaufort Sea ringed seals with the average abundance estimate of 230,673 seals from the eastern Chukchi Sea, results in a total of 249,000 seals.

It is not known whether the more recent lower densities correspond to an actual reduction in the population or are related to earlier survey dates in 1990s. At earlier dates, a higher proportion of the seals are still using their lairs and are unavailable to be counted by aerial surveyors (Kelly et al. 2004). Frost et al. (2002) reanalyzed the earlier estimates for 1985-87 and reported ringed seal densities surveyed between Oliktok Point and Flaxman Island ranged from 0.56 to 1.16 seals/km^2 (about half the density originally reported) during the spring seasons of 1985 to 1987. Based on more recent surveys from 1996 through 1999, ringed seal density in fast-ice areas between Oliktok Point and Flaxman Island ranged from 0.48 to 0.77 seals/km^2 (Frost et al. 2002).

BP's Northstar project, located near Prudhoe Bay, developed a seal survey and monitoring program to establish a baseline prior to construction and to monitor during initial operations for comparison. Ringed seal densities reported by Moulton et al. (2002) ranged from 0.39 to 0.63 seals/km^2 prior to construction in the Northstar development area. Ringed seal densities close to Northstar in 2000, 2001, and 2002 were not reduced relative to those farther away or to those during the 1997 to 1999 pre-development period (Moulton et al. 2003 a, b), however, because aerial surveys will underestimate actual seal densities, the above density figures should be used as minimum estimates.

During summer, ringed seals are found dispersed throughout open water areas, although in some regions they move into coastal areas (Smith 1987; Harwood and Stirling 1992). During the open water period, ringed seals in the eastern Beaufort Sea are widely dispersed as single animals or small groups (Harwood and Stirling 1992). Marine mammal monitoring in the nearshore central Beaufort Sea confirms these generalities (Moulton and Lawson 2002; Williams et al. 2004, Green et al. 2005, in progress).

Large concentrations of ringed seals are not expected to be encountered near each of the proposed seismic activity areas in the eastern Beaufort Sea during the summer and fall time period. The Alaska stock of ringed seals is not classified as a strategic stock by the NMFS.

Spotted Seal (*Phoca largha*)

Spotted seals occur in the Beaufort, Chukchi, Bering and Okhotsk Seas, and south to the northern Yellow Sea and western Sea of Japan (Shaughnessy and Fay 1977). Based on satellite tagging studies, spotted seals migrate south from the Chukchi Sea in October and pass through the

Bering Strait in November and overwinter in the Bering Sea along the ice edge (Lowry et al. 1998).

During spring when pupping, breeding, and molting occur, spotted seals tend to prefer small floes (less than 20 m in diameter), and inhabit mainly the southern margin of the ice in the Okhotsk and Bering Seas, with movement to coastal habitats after the retreat of the sea ice (Shaughnessy and Fay 1977; Quakenbush 1988; Rugh et al. 1997; Simpkins et al. 2003).

In summer, the majority of spotted seals are found in the Bering and Chukchi Seas, but do range into the Beaufort Sea (Rugh et al. 1997; Lowry et al. 1998) from July until September. At this time of year, spotted seals haul out on land part of the time, but also spend extended periods at sea. The seals are most commonly seen in bays, lagoons, and estuaries and are typically not associated with pack ice unless it is near to shore.

A small number of spotted seal haul-outs are documented in the central Beaufort Sea near the deltas of the Colville River and, previously, the Sagavanirktok River. Historically, these sites supported as many as 400 to 600 spotted seals, but in recent times less than 20 seals have been seen at any one site (Johnson et al. 1999).

As the ice cover thickens with the onset of winter, spotted seals leave the northern portions of their range and move into the Bering Sea (Lowry et al. 1998).

Previous studies from 1996 to 2001 indicate that few spotted seals (a few tens) utilize the central Alaskan Beaufort Sea (Moulton and Lawson 2002; Treacy 2002 a, b). In total, there are probably no more than a few tens of spotted seals along the coast of the central Alaska Beaufort Sea during summer and early fall with very few, if any, occurring in the eastern portion of the Beaufort Sea.

A reliable abundance estimate for spotted seal is not currently available (Angliss and Outlaw 2005), however, early estimates of the size of the world population of spotted seals was 335,000 to 450,000 animals and the size of the Bering Sea population, including animals in Russian waters, was estimated to be 200,000–250,000 animals (Burns 1973 *cited in* Angliss and Lodge 2004). The total number of spotted seals in Alaskan waters is not known (Angliss and Lodge 2004), but the estimate is most likely between several thousand and several tens of thousands (Rugh et al. 1997). Using maximum counts at known haul-outs from 1992 (4,135 seals), and a preliminary correction factor for missed seals developed by the Alaska Department of Fish and Game (Lowry et al. 1994), an abundance estimate of 59,214 was calculated for the Alaska stock (Angliss and Lodge 2004).

The activities associated with the proposed seismic work in the eastern Beaufort Sea are expected to encounter few to no spotted seals. The Alaska stock of spotted seals is not classified as a strategic stock by NMFS.

Bearded Seal (*Erignathus barbatus*)

Bearded seals are associated with sea ice and have a circumpolar distribution (Burns 1981). Bearded seals are predominately benthic feeders, and prefer waters less than 200 m in depth.

Seasonal movements of bearded seals are directly related to the advance and retreat of sea ice and to water depth (Kelly 1988). During winter they are most common in broken pack ice and in

some areas also inhabit shorefast ice (Smith and Hammill 1981). In Alaska waters, bearded seals are distributed over the continental shelf of the Bering, Chukchi, and Beaufort Seas, but are more concentrated in the northern part of the Bering Sea from January to April (Burns 1981).

During winter, most bearded seals in Alaskan waters are found in the Bering Sea. In the Chukchi and Beaufort Seas, favorable conditions are more limited, and consequently, bearded seals are less abundant there during winter. From mid- to late-April to June, as the ice recedes, some of the bearded seals migrate northward through the Bering Strait and spend the summer along the ice edge in the Chukchi Sea (Burns 1967; Burns 1981).

Recent spring surveys along the Alaskan coast indicate that bearded seals tend to prefer areas of between 70 and 90 percent sea-ice coverage, and are typically more abundant greater than 20 nm of shore, with the exception of high concentrations nearshore to the south of Kivalina in the Chukchi Sea (Bengtson et al. 2000; Simpkins et al. 2003).

During the summer in the Chukchi Sea, bearded seals are most associated with the pack ice edge near the continental shelf. The nearshore areas of the central and western Beaufort Sea provide somewhat more limited habitat because the continental shelf is narrower and the pack ice edge frequently occurs seaward of the shelf and over waters greater than 200 m in depth. The preferred habitat in the Beaufort Sea during the open water period is the continental shelf seaward of the scour zone.

A reliable abundance estimate for the Alaska stock of bearded seals is currently not available. The most recent surveys occurred in May-June of 1999 and 2000 between Shismaref and Barrow with average densities of 0.07 seals per km^2 and 0.14 seals per km^2, respectively, however, there is no correction factor available for these data. Early estimates of the Bering-Chukchi Sea population ranged from 250,000 to 300,000 (Burns 1981).

No reliable estimate of bearded seal abundance is available for the Beaufort Sea (Angliss and Lodge 2002). Aerial surveys conducted by Minerals Management Services in fall 2000 and 2001 sighted a total of 46 bearded seals during survey flights conducted between September and October (Treacy 2002 a, b), with all but two sightings recorded east of 147 degrees W and all sightings were within 40 nm of shore. Aerial surveys conducted from 1997 to 2002 in the vicinity of Northstar Island also reported small numbers (up to 15) of bearded seals (Moulton et al. 2003c).

The proposed seismic activity areas may encounter bearded seals during the open-water season, however, the number of bearded seals is expected to be small. The Alaska stock of bearded seals is not classified by NMFS as a strategic stock.

5. The type of incidental taking authorization that is being requested (i.e. takes by harassment only; takes by harassment, injury and /or death) and the method of incidental taking:

The only type of incidental taking sought in this application is that of takes by noise harassment. The only sources of project created noise will be those stemming from of the vessels M/V Galivar, M/V Alex Gordon, the as yet unidentified vessels to be used for site clearance and shallow hazards, and geotechnical coring; operation of the seismic airguns and other acoustic registration equipment used in the site clearance program; and noise generated by the

geotechnical coring activity. For estimates of takes associated with these noise sources, see Section 6, below].

6. Numbers of marine mammals that may potentially be taken:

Shell seeks authorization for potential "taking" of small numbers of marine mammals under the jurisdiction of the NMFS in the proposed region of activity. Species for which authorization is sought are bowhead, gray, and beluga whales, and ringed, spotted, and bearded seals. Polar bears will be covered in a separate authorization with USFWS.

The only anticipated impacts to marine mammals associated with noise propagation from vessel movement, seismic acquisition operations, and seabed profiling work would be temporary and short term displacement of seals and whales from within ensonified zones produced by such noise sources.

The three distinct areas of seismic acquisition for the eastern Beaufort Sea proposed by Shell is not expected to "take" more than small numbers of marine mammals, or have more than a negligible effect on their populations.

Basis for Estimating Numbers of Marine Mammals that Might be "Taken by Harassment"

Taking into account the small total volume and relatively low sound output of the airgun sources, and mitigation measures that are planned, effects on cetaceans and pinnipeds are generally expected to be limited to avoidance of a small area (ensonification zone) around the seismic operation and short-term changes in behavior, falling within the MMPA definition of "Level B harassment".

The methods to estimate "take by harassment" and present estimates of the numbers of marine mammals that might be affected during the proposed seismic acquisition areas in the Beaufort Sea are described below. The density estimates for the species covered under this IHA are based on the estimates developed by LGL (2005) University of Alaska IHA and used here for consistency. Density estimates are based on the data from Moore et al. (2000) on summering bowhead, gray, and beluga whales in the Beaufort and Chukchi Seas, and relevant studies on ringed seal estimates including Stirling et al. (1982), Kingsley (1986), Moulton and Williams (2003) in relation to polar bear densities within the Beaufort Sea.

This section provides estimates of the number of potential "exposures" to sound levels greater than 160 dB re 1 μPa (rms) and greater than 170 dB. The greater than 160 dB criterion is applied for all species of cetaceans and pinnipeds; the criterion is applied for delphinids and pinnipeds. The 170 dB criterion is considered appropriate for those two groups, which tend to be less responsive, whereas the 160 dB criterion is considered appropriate for other cetaceans (LGL 2005).

The following estimates are based on a consideration of the number of marine mammals that might be disturbed appreciably by ~5,556 km of seismic surveys in three distinct areas of the eastern- and mid-Beaufort Sea. Source arrays are composed of identically tuned Bolt gun sub-arrays operating at 2000 psi, air pressure. In general, the signature produced by an array composed of multiple sub-arrays has the same shape as that produced by a single sub-array while the overall acoustic output of the array is determined by the number of sub-arrays employed.

The gun arrangement for the 1,049 in^3 sub-array is detailed below and is comprised of three subarrays comprising a total 3,147 in^3 sound source. The anticipated radii of influence of the bathymetric sonars and pinger are less than those for the airgun configurations described in Attachment A. It is assumed that, during simultaneous operations of those additional sound sources and the airgun(s), any marine mammals close enough to be affected by the sonars or pinger would already be affected by the airgun(s). In this event, marine mammals are still not expected to exhibit more than short-term and inconsequential responses, and such responses have not been considered to constitute "taking" (NMFS 2001), therefore, potential taking estimates only include noise disturbance from the use of airguns.

The specifications of the equipment, including site clearance activities, to be used and areas of ensonification are described more fully in Attachment B.

Cetaceans

For whales, Moore et al. (2000) likely offer the most current data to estimate densities of belugas, bowheads and gray whales during summer in the Beaufort and Chukchi Seas, however, densities of beluga and gray whales are likely overestimated due to the fact that most beluga and gray whales are found west of the three seismic survey areas. Density estimates for bowhead whale were conducted by air during the bowhead migration and, while likely accurate for the areas proposed for seismic activities within the eastern Beaufort Sea, will overestimate the numbers of "take by harassment" (noise disturbance) because activities will occur in July and August when bowhead whales are not present.

Table 6-1 gives the average and maximum densities for each cetacean species likely to occur within the project areas based on the density estimates developed and corrected as needed by LGL for the Beaufort and Chukchi Seas (LGL 2005), however, these estimates were based on surveys of offshore waters (less than 100 m in depth). Whereas, all seismic activities within the three areas proposed under this IHA will occur in waters between 20 and 40 m in depth.

The estimated numbers of potential exposures presented in Table 6-1 are based on the 160 dB re 1 µPa (rms) criteria for most cetaceans, because this range is assumed to be the sound source level at which marine mammals may change their behavior sufficiently to be considered "taken by harassment."

Pinnipeds

Ringed, spotted, and bearded seals are all associated with sea ice, and most census methods used to determine density estimates for pinnipeds are associated with counting the number of seals hauled out on ice.

Table 6-1. Expected densities of marine mammals during open-water seismic surveys proposed for offshore areas of the Chukchi and Beaufort Seas.

Species	Average Density (#/km²) [1]	Maximum Density (#/km²) [1]
Cetaceans		
bowhead whale	0.0064	0.0256
gray whale	0.0045	0.0179
beluga whale	0.0034	0.0135
Pinnipeds		
ringed seal	0.251	0.444
spotted seal	0.0001	0.0005
bearded seal	0.0128	0.0226

1. These estimates are calculated from various sources including Moore et al. 2000, Stirling et al. 1982, Kingsley 1986, and presented in LGL 2005, Table 4.

Correction factors have been developed for most pinniped species that address biases associated with detectability and availability of a particular species. Although extensive surveys of ringed and bearded seals have been conducted in the Beaufort Sea, the majority of the surveys have been conducted over the landfast ice and few seal surveys have been in open water. The most comprehensive survey dataset on ringed seals (and bearded seal) from the central and eastern Beaufort Sea was conducted on offshore pack ice in late spring (Kingsley 1986). It is important to note that all proposed activities will be conducted during the open-water season and density estimates used here were based on counts of seals on ice. Therefore, densities and potential take numbers will overestimate the numbers of seals that would likely be encountered and/or exposed because only the animals in the water would be exposed to the seismic and clearance activity sound sources.

Although the estimated numbers of potential exposures presented in Table 6-1 are based on two sound source ranges (greater than 160 dB and greater than_170 dB re 1 µPa (rms)), for most pinnipeds, the 170 dB threshold should be used to determine "take by harassment" because this range is assumed to be the sound source level at which most pinnipeds may change their behavior in reaction to increased sound exposure.

Exposure Calculations for Cetaceans and Pinnipeds

The number of exposures of a particular species to sound levels between 160 dB and 180 dB re 1 µPa (rms) was calculated by multiplying:

- the expected species density average and maximum), taken from LGL (2005) and shown in Table 6-1,
- the anticipated total line-kilometers of operations with the three 1,049 in^3 subarrays (5,556 km),
- the cross-track distances within which received sound levels are predicted to be between greater than 160 dB and greater than 170dB (Figure 6-1 and Table 6-3).

Table 6-2. Estimates of possible numbers of marine mammals exposures to 160 dB and >170 dB during Shell's proposed seismic acquisition program in the eastern Beaufort Sea.

Species	Avg Density at greater than 160 dB	Max Density at greater than 160 dB	Avg Density at greater than 170 dB	Max Density at greater than 170 dB	Requested Take Authorization
Cetaceans					
bowhead whale	46	185	30	121	**185**
gray whale	33	129	21	85	**129**
beluga whale	25	98	16	64	**98**
Pinnipeds					
ringed seal	1,813	3,207	1,185	2,097	**2,097**
spotted seal	1	4	0	2	**2**
bearded seal	92	163	60	107	**107**
Total	**2,009**	**3,785**	**1,314**	**2,475**	

The last column of Table 6-2 also shows the shows the numbers of animals for which "harassment take authorization" is requested. No other cetacean or pinniped species are suspected to occur within the eastern portion of the Beaufort Sea and are not included under this IHA because of the unlikely event of an encounter. The results and estimated request for take authorization is displayed in Table 6-2.

Applying the method described above, and multiplying the distance times 2 (Table 6-3), approximately 7,223 km^2 and 4,723 km^2 would be within the greater than 160 dB and greater than 170 dB ensonification zones, respectively. Based on this method, the "average" and "maximum" estimates of the numbers of marine mammal exposures to the proposed seismic arrays with received levels between ≥160 and <180 dB re 1 µPa (rms) were obtained using the "average" and "maximum" densities from Tables 6-1.

Table 6-3. Sound level and distance from sound sources based on the proposed 3,147 cubic inch array at a depth of 6 m.

Sound Level	Distance from Source	Area of Ensonification (Distance x 2)
160 dB (rms) 169 dB (Peak-Peak) $2.8X10^{-3}$ Bar	< 650 meters	1,300 meters
170 dB (rms) 179 dB (Peak-Peak) $8.9X10^{-3}$ Bar	< 425 meters	850 meters
180 dB (rms) 189 dB (Peak-Peak) $2.8X10^{-2}$ Bar	< 225 meters	450 meters
190 dB (rms) 199 dB (Peak-Peak) $8.9X10^{-2}$ Bar	< 120 meters	240 meters

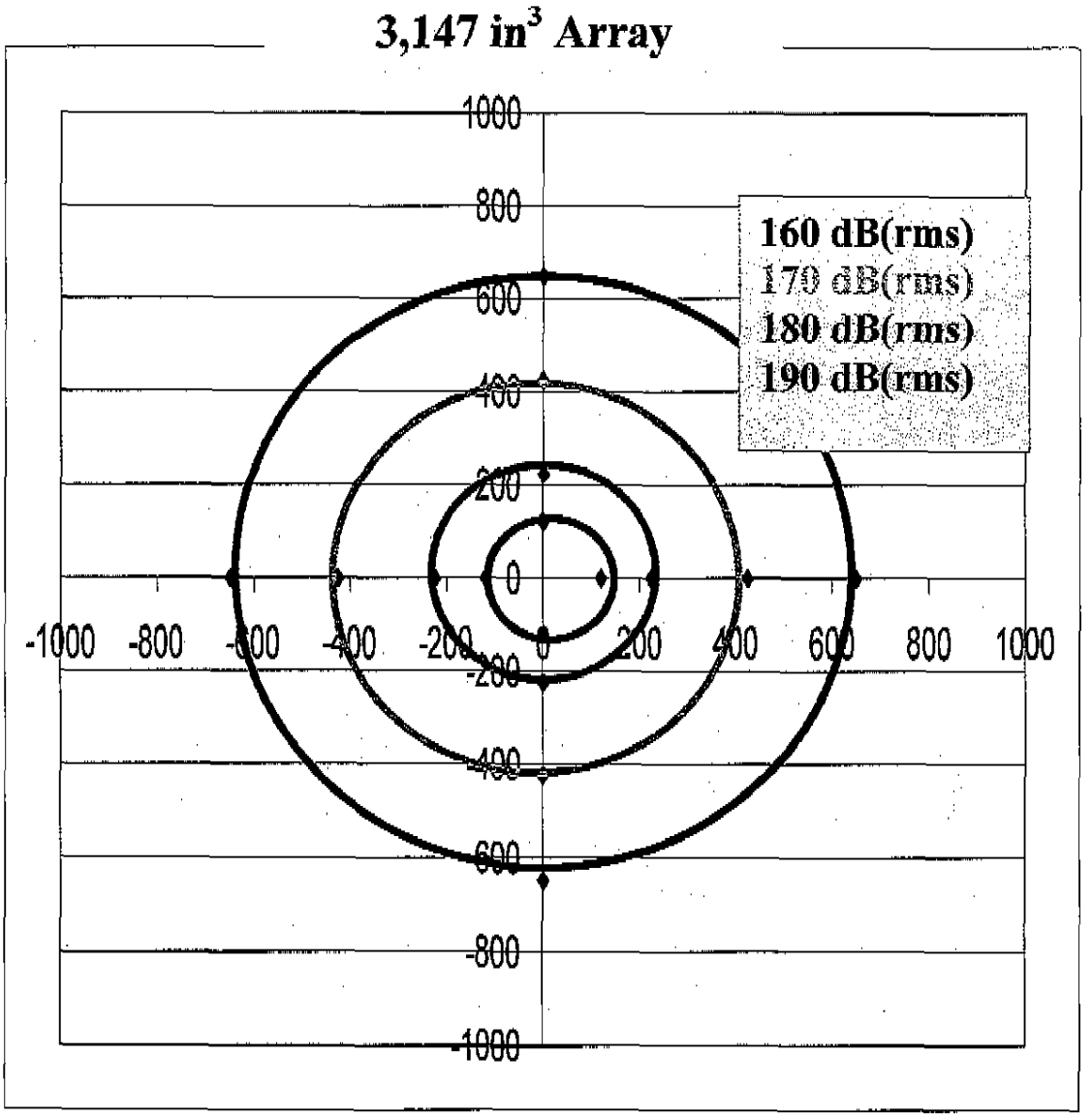

Figure 6-1. Estimated Radii of rms Sound Level output from simulation of 3,147 cubic inch source array.

Estimates for the ESA-listed bowhead whale may be exposed to noise levels of 160 dB; however, as stated earlier, proposed activities would occur when bowheads are not present in the area or in very low numbers. The estimated average and maximum numbers for bowhead whales are 46 and 185, *respectively (Table 6-2).*

Gray and beluga whales also have the potential for exposure, particularly near Area 3. The average and maximum estimates of the number of exposures for gray whales are 33 and 129, and 25 and 98 for beluga whales (Table 6-2).

As stated earlier, density information for pinnipeds stems from on-ice surveys and likely overestimates the number of seals that may actually receive higher sound sources from seismic (airgun) and site clearance (sonar) activities.

Ringed seals would be the most prevalent marine mammal species encountered at each of the three proposed seismic acquisition areas, and would account for over 80 or 84 percent of the marine mammals that might be exposed to seismic sounds equal to or greater than 170 dB or

160 dB, respectively. Pinnipeds are not likely to react to seismic sounds unless they are ≥170 dB re 1 μPa (rms), and Moulton and Lawson (2002) indicated that most pinnipeds exposed to 170 dB do not visibly react. Under this IHA, the requested take authorization for all pinnipeds uses the maximum density between 170 and 179 dB instead of the 160 dB threshold. This decision to use the lower estimated number is based on the theory that surveys for pinnipeds within the Beaufort Sea, and elsewhere, are based on on-ice counts which will overestimate the number of potential exposures (i.e., only a portion of the animals are in the water, and therefore, could be exposed).

Spotted and bearded seals may be encountered in much small numbers than ringed seals, but also have the potential for exposure. The average and maximum estimates of the number of exposures for spotted seals are 0 and 2, and 60 and 107 for bearded seals (Table 6-2).

Effects on polar bears are anticipated to be minor at most. No estimate of polar bears that may be harassed by noise associated with seismic activities are given, however this species will be addressed under a separate IHA with the USFWS. Most polar bears that may be encountered will be on ice or nearshore and would be unaffected by the proposed activities, however, for the small number of bears that are in the water, any received levels of airgun (and sonar) sounds are reduced substantially just below the surface, relative to those at deeper depths, because of the pressure release effect at the surface.

Summary

The proposed survey areas within the eastern and central Beaufort Sea will involve towing three subarray airgun configurations that introduce pulsed sounds into the ocean, along with simultaneous operation of a multi-beam sonar and hydrographic echo sounder, and the use of a pinger. Routine vessel operations, other than the proposed operations by the airgun(s), are conventionally assumed not to affect marine mammals sufficiently to constitute "taking." Taking into account the small total volume and relatively low sound output of the airgun sources, and mitigation measures that are planned, effects on cetaceans and pinnipeds are generally expected to be limited to avoidance of a small area around the seismic operation and short-term changes in behavior, falling within the MMPA definition of "Level B harassment". The requested "take authorization" for each species is based on the estimated *maximum number of exposures* to greater than or equal to 160 dB re 1 μPa (rms) for all cetaceans and greater than or equal to 170 dB re 1 μPa (rms) for pinnipeds (i.e., the highest of the various estimates where a behavioral change may be expected). In addition, the estimated numbers of animals potentially exposed to sound levels sufficient to cause appreciable disturbance are very low percentages of the population sizes in the Beaufort and Chukchi Seas.

Based on the above threshold criterion, the number of ESA listed bowhead whales that may be exposed to sounds greater than or equal to 160 dB re 1 μPa (rms) represent approximately 1.7 percent of the estimated population within the Beaufort and Chukchi Seas (Table 4-1 in Section 4) however, seismic surveys conducted in July and August would occur when bowhead whales are not present.

The number of estimated exposures on beluga and gray whales is also very low in relation to estimated population levels, representing 0.2 and 0.7 percent projected. Few if any of these species are expected to be encountered in any numbers during the period of operations in the Beaufort Sea, with the exception of Area 3 located just east of Harrison Bay.

No reliable abundance numbers currently exist for ringed, spotted, and bearded seals for the Beaufort Sea, however, the potential number of exposures would be a very small fraction of earlier abundance estimates.

For both cetaceans and pinnipeds likely to be encountered within the activity areas, the short-term exposures to airgun sounds are not expected to result in any long-term negative consequences for the individuals or their populations. Furthermore, the estimated number of animals potentially exposed and requested under a "take" authorization, will be likely be much less for some species (e.g., bowhead whale) because of the period of seismic acquisition, and the survey and mitigation plan which contains efforts to further avoid take.

7. The anticipated impact of the activity on the species or stock:

The only anticipated impacts to marine mammals associated with noise propagation from vessel movement, seismic airgun operations, and seabed profiling and coring work would be the temporary and short term displacement of seals and whales from within ensonified zones produced by such noise sources. In the case of bowhead whales that displacement might well take the form of a deflection of the swim paths of migrating bowheads away from (seaward of) received noise levels greater than 160 db (Richardson, W. J. G. W. Miller and C. R. Greene Jr. 1999). The cited and other studies conducted to test the hypothesis of the deflection response of bowheads have determined that bowheads return to the swim paths they were following at relatively short distances after their exposure to the received sounds. There is no evidence that bowheads so exposed have incurred injury to their auditory mechanisms. Additionally, there is no conclusive evidence that exposure to sounds exceeding 160 db have displaced bowheads from feeding activity (Richardson, W.J and D.H. Thomson [eds]. 2002).

There is no evidence that seals are more than temporarily displaced from ensonified zones and no evidence that seals have experienced physical damage to their auditory mechanisms even within ensonified zones.

8. The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses:

There could be an adverse impact on the Inupiat bowhead subsistence hunt if the whales were deflected seaward (further from shore) in traditional hunting areas. The impact would be that whaling crews would necessarily be forced to travel greater distances to intercept westward migrating whales thereby creating a safety hazard for whaling crews and/or limiting chances of successfully striking and landing bowheads. This potential impact is mitigated by application of the procedures established in the CAA between the seismic operators and the AEWC and the whaling captains' associations of Kaktovik, Nuiqsut and Barrow. The times and locations of seismic and other noise producing sources are curtailed during times of active scouting and whaling within the traditional subsistence hunting areas of the three potentially affected communities. (See Section 12, below).

9. Anticipated impact on habitat:

The seismic and site clearance activities proposed will not result in any permanent impact on habitats used by marine mammals, or to their prey sources. Seismic activities will occur during the time of year when bowhead whales are present (i.e., mid- to late-July through September).

Any effects would be temporary and of short duration at any one place. The primary potential impacts to marine mammals is associated with elevated sound levels from the proposed seismic (airguns) and site clearance (sonar) work, and discussed in detail earlier in Sections 6 and 7.

A broad discussion on the various types of potential effects of exposure to seismic on fish and invertebrates can be found in LGL (2005), and includes a summary of direct mortality (pathological/physiological) and indirect (behavioral) effects.

Mortality to fish, fish eggs and larvae from seismic energy sources would be expected within a few meters (0.5 to 3 m) from the seismic source. Direct mortality has been observed in cod and plaice within 48 hours that were subjected to seismic pulses 2 m from the source (Matishov 1992), however other studies did not report any fish kills from seismic source exposure (La Bella et al. 1996, IMG 2002, Hassel et al. 2003). To date, fish mortalities associated with normal seismic operations are thought to be slight. Saetre and Ona (1996) modeled a worst-case mathematical approach on the effects of seismic energy on fish eggs and larvae, and concluded that mortality rates caused by exposure to seismic are so low compared to natural mortality that issues relating to stock recruitment should be regarded as insignificant.

Limited studies on physiological effects on marine fish and invertebrates to acoustic stress have been conducted. No significant increases in physiological stress from seismic energy were detected for various fish, squid, and cuttlefish (McCauley et al. 2000) or in male snow crabs (Christian et al. 2003). Behavioral changes in fish associated with seismic exposures are expected to be minor at best. Because only a small portion of the available foraging habitat would be subjected to seismic pulses at a given time, fish would be expected to return to the area of disturbance anywhere from 15-30 minutes (McCauley et al. 2000) to several days (Engas et al. 1996).

Available data indicates that mortality and behavioral changes do occur within very close range to the seismic source, however, the proposed seismic acquisition activities in three distinct areas in the eastern Beaufort Sea is predicted to have a negligible effect to the prey resource of the various life stages of fish and invertebrates available to marine mammals occurring during the project's 60-day duration which will cover approximately 5,556 km.

10. Anticipated impact of habitat loss or modification:

The total footprint of each of the three activity areas 1, 2, and 3 (see Attachment A or B) cover approximately 378,000 acres, 126,300 acres, and 213,200 acres, respectively. The effects of the planned seismic activity at each of the three locations on marine mammal habitats and food resources are expected to be negligible, as described in Section 9. It is estimated that only a small portion of the animals utilizing the areas of the proposed activities would be temporarily displaced.

During the period of seismic acquisition (mid-July through September 30), most marine mammals would be dispersed throughout the area. The peak of the bowhead whale migration through the Beaufort Sea typically occurs in October, and efforts to reduce potential impacts during this time will be addressed with the actual start of the migration and with the whaling communities. The timing of seismic activities in the eastern Beaufort Sea will take place when the whales are not present, or in very low numbers. Starting in late August bowheads may travel in proximity to the aforementioned activity areas to hear sounds from vessel traffic and seismic

activities, of which some might be displaced seaward by the planned activities. The numbers of cetaceans and pinnipeds subject to displacement of 0.6 to 1.2 km and 0.4 to 0.9 km (or more), respectively, are small in relation to abundance estimates for the mammals addressed under this IHA.

In addition, feeding does not appear to be an important activity by bowheads migrating through the eastern and central part of the Alaskan Beaufort Sea in most years. In the absence of important feeding areas, the potential diversion of a small number of bowheads from part is not expected to have any significant or long-term consequences for individual bowheads or their population. Bowheads, gray, or beluga whales are not predicted to be excluded from any habitat.

The proposed activities are not expected to have any habitat-related effects that would produce long-term affects to marine mammals or their habitat due to the limited extent of the acquisition areas and timing of the activities.

11. The availability and feasibility (economic and technological), methods, and manner of conducting such activity or means of effecting the least practicable impact upon affected species or stock, their habitat, and of their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance:

Five main mitigations are proposed: (1) the timing and locations for active seismic acquisition work will be scheduled to curtail operations when whaling captains inform the operator that they are scouting or hunting within traditional hunting areas; (2) to configure airguns in a manner that directs energy primarily down to the seabed thus decreasing the range of horizontal spreading of seismic noise; (3) using a seismic energy source which is as small as possible while still accomplishing the geophysical objectives; (4) using the ramp-up and soft start methods of initiating seismic operations which is intended to alert any marine mammals either within or approaching an operating airgun array so that they may swim away from the source; and (5) curtailing active seismic work when the marine mammal observers visually sight (from shipboard) or aerially the presence of marine mammals within identified ensonified zones. Details of the proposed mitigations are discussed further in the Marine Mammal Monitoring and Mitigation Measures Plan that is included as Attachment C to this application.

12. Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must submit a plan of cooperation or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses. A plan must include the following:

i. A statement that the applicant has notified and provided the affected subsistence community with a draft plan of cooperation.

ii A schedule for meeting with the affected subsistence communities to discuss proposed activities and to resolve potential conflicts regarding any aspects of either the operation or the plan of cooperation.

iii A description of what measures the applicant has taken and/or will take to ensure that proposed activities will not interfere with subsistence whaling or sealing; and

iv What plans the applicant has to continue to meet with the affected communities, both prior to and while conducting activity, to resolve conflicts and to notify the communities of any changes in the operation.

Negotiations were initiated beginning in summer of 2005 with the AEWC to create a CAA between Shell and WesternGeco for 2006, and the subsistence hunting communities of Barrow, Nuiqsut, and Kaktovik. The CAA will cover both this proposed Beaufort Sea seismic program (including deep seismic, site clearance, shallow hazard surveys and a geotechnical seabed coring program) and the Chukchi Sea deep seismic survey that is being applied for in a separate IHA application. The most recent meeting between the operator and the AEWC occurred in October, 2005 with representatives of the NSB also present in Fairbanks during the annual meeting of the Alaska Federation of Natives.

Shell and Western Geco, at the suggestion of the AEWC and the NSB, will hold community meetings with the Beaufort Sea whaling communities of Barrow, Nuiqsut and Kaktovik in early 2006.

The CAA will incorporate all appropriate measures and procedures regarding the timing and areas of the operator's planned activities (to wit: times and places where seismic operations will be curtailed or moved in order to avoid potential conflicts with active subsistence whaling and sealing); communications system between operator's vessels and whaling and hunting crews (i.e., the communications center will be located in Deadhorse with links to Kaktovik, Nuiqsut, Cross Island, and Barrow); provision for marine mammal observers/Inupiat communicators aboard all project vessels; conflict resolution procedures; and provisions for rendering emergency assistance to subsistence hunting crews.

If requested, post season meetings will also be held to assess the effectiveness of the 2006 CAA, to address how well conflicts (if any) were resolved; and to receive recommendations on any changes (if any) might be needed in the implementation of future CAAs.

It is anticipated that a final draft of the 2006 CAA for the Beaufort and Chukchi Seas will be available for consideration and review by NMFS and the MMS by early spring.

13. The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on the population of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding:

The proposed Marine Mammal Monitoring and Mitigation Measures Plan for the deep seismic, site clearance and shallow hazards surveys is included as Attachment C of this application. It should be noted that all sightings of polar bears and walrus by shipboard or aerial observers will be recorded and reported to the USFWS.

14. Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects:

Marine mammal studies in the Beaufort Sea may be undertaken by various agencies and programs during the course of the 2006 open-water season. It is unclear if these studies might be relevant to Shell's proposed activities. Shell is prepared to share information obtained during implementation of our marine mammal monitoring program with a variety of groups who may find the data useful in their research. A suggested list of recipients includes:

- The NSB Department of Wildlife Management (C. George)
- The USFWS Office of Wildlife Management (C. Perham)
- The USGS Alaska Science Center Polar Bear Research Program (S. Amstrup)
- The MMS's Bowhead Whale Aerial Survey Program (C. Monnett)

Literature Cited for Beaufort IHA

Sections 3, 4, 6, 9, and 10

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Offshore Alaska, Beaufort Sea

Site Clearance Surveys

Overview / Description

October 31, 2005

Table of Contents

Site Clearance Surveys

Purpose

Offshore site clearance survey data are acquired and analyzed to ensure that exploratory drilling, appraisal drilling, and associated development activities are conducted to minimize the risk to people, assets, and to protect the natural environment.

Background

Before drilling or development activities begin, a site clearance survey and analysis is conducted to identify and/or evaluate potentially hazardous conditions at or below the seafloor which could affect the safety of operations. Examples of hazardous conditions, features, or processes include: Subsurface Faults, Fault Scarps, Shallow Gas, Steep-walled canyons and slopes, Buried channels, Current Scour, Migrating sedimentary bedforms, Ice Gouging, Permafrost, Gas Hydrates, Unstable Soil Conditions, Pipelines, Anchors, Ordnance, Shipwrecks, and Other geological or man-made features.

The United States Department of the Interior, Minerals Management Service (MMS), Alaska Outer Continental Shelf (OCS) Region also requires pre-exploratory and pre-development investigations by lessees/operators on leased lands to ensure safe conduct of oil and gas operations on the OCS. To provide guidance to the lessee/operators the MMS prepared the following Notice to Lessees (NTL) and Operators which are followed for site clearance surveys:

- NTL 05-A01 "Shallow Hazards Survey and Evaluation for OCS Exploration and Development Drilling"
- NTL05-A02 "Shallow Hazards and Evaluation for OCS Pipeline Routes and Rights of Way"
- NTL05-A03 "Archaeological Survey and Evaluation for Exploration and Development Activities."

Offshore site clearance surveys use various geophysical methods and tools to acquire graphic records of seafloor and sub-seafloor geologic conditions. The data acquired and the type of investigations outlined in this document are performed routinely for most exploratory drilling and production platforms, submarine pipelines, port facilities, and other offshore projects. High-resolution geophysical data such as two-dimensional, high-resolution multi-channel seismic, medium penetration seismic, subbottom profiler, side scan sonar, multibeam bathymetry, magnetometer and possibly piston core soil sampling are typical types of data acquired. This data is interpreted to define geologic and geotechnical conditions at the site and to assess the potential engineering significance of these conditions. Upon completion of data acquisition and interpretation a detailed site assessment report that satisfies the latest NTL will be prepared.

Geophysical Tools for Site Clearance

High-Resolution seismic profiling

In this method, reflected sound energy, often called acoustic or seismic energy, produces graphic images of seafloor and sub-seafloor features. These systems transmit the acoustic

energy from various sources called transducers that are attached to the hull of the vessel or towed astern. Part of this energy is reflected from the seafloor and from geologic strata below the seafloor. This reflected energy is received by the hydrophone or streamer and is recorded to produce seismic records or profiles. Seismic profiles often resemble geologic cross-sections along the course traveled by the survey vessel.

In most site surveys, we will operate several high-resolution profiling systems simultaneously to obtain detailed records of seafloor and near seafloor conditions. A typical survey would include data acquisition using a shallow penetration profiler or subbottom profiler (1 – 12.0 kHz, typically 3.5 kHz), medium penetration system or boomer/sparker/airgun (400-800 Hz) and a deep penetrating hi-res multi-channel seismic system (20-300 Hz) not to be confused with the deep seismic used for hydrocarbon exploration. These three profiling systems complement each other since each system achieves different degrees of resolution and depths of sub-seafloor penetrations.

Side Scan Sonar

Unlike seismic profiling systems, which produce a vertical profile along the vessel's path, side scan sonar systems provide graphic records that show two-dimensional (map) views of seafloor topography and of objects on the seafloor. The sonar images provide a swath display / record covering an area on the seafloor up to several hundred feet on both sides of the survey trackline. The Side Scan Sonar transmits very high-frequency acoustic signals (100 – 410 kHz) and records the reflected energy from the seafloor. Signals reflected from the seafloor are displayed on a continuous record produce by a two-channel recorder. Reflected signals normally appear as dark areas on the record whereas shadows behind objects appear as light or white areas. The intensity and distribution of reflections displayed on the sonar image depend on the composition and surface texture of the reflecting features, on their size, and on their orientation with respect to the transducers in the towfish.

Line spacing and display range are designed to ensure 100 percent coverage of the proposed survey area in the prime survey line direction, with additional tie-lines acquired in an orthogonal direction.

Side scan sonar data are useful for mapping areas of boulders, rock outcrops, and other areas of rough seafloor, and for determining the location and trends of seafloor scarps and ice gouges. These data are also used to locate shipwrecks, pipelines, and other objects on the seafloor.

Multi-beam Bathymetry

Multi-beam Bathymetric systems are either hull mounted or towed astern of the survey vessel. The system transmits acoustic signals (200-500 kHz) from multiple projectors propagating to either side of the vessel at angles that vary from vertical to near horizontal. The locations of the soundings cover a swath whose width may be equal to many times the waterdepth. By adjusting the spacing of the survey tracklines such that adjacent swaths are overlapping, we obtain depth information for 100 percent of the bottom in the survey area. The time it takes to receive the signals as well as signal intensity, position, and other characteristics for echoes received across the swath are used to calculate depth of each individual beam transmitted across the swath.

Water column sound velocity is obtained using a CTD (conductivity, temperature, depth) or

velocity probe capable of recording in the maximum water depths expected within the survey area. The water column velocity is used to adjust or correct the depth measured by the multibeam system.

Magnetometer

The marine magnetometer system detects and records the total intensity of the earth's magnetic field. This is the only geophysical tool used in the site survey process that is not an acoustic system. The magnetometer is designed to be particularly sensitive to local variations in field intensity. It is used to detect shipwrecks, and other ferrous-metal objects on or just below the seafloor. The total intensity is recorded as a single line on a strip chart. Normally this line is relatively smooth and shows no abrupt variation in field intensity above ambient background noise. As the sensor passes near a ferrous metal object, the field intensity changes and the normally smooth trace becomes a sharp peak and/or depression. The amplitude shape of an individual magnetic anomaly depends on the size, composition, orientation, and distance from the sensor.

This system is most useful when used with the side scan sonar because the identity of an object cannot be determined solely from the character of a magnetic anomaly.

Navigation

For design and engineering purposes, the locations of potentially significant seafloor and sub-seafloor geologic features must be determined accurately. Thus, precise positioning during geophysical data acquisition operations is essential. Surface positioning of the survey vessel is required to be known within 5 meters (m). Position fixes should be digitally logged at least every 12.5 m along vessel track and annotated on all records at intervals no greater than 150 m. Surface positioning is typically achieved using a Differential Global Positioning System (DGPS) installed on the survey vessel.

Survey Grid Line Spacing

Acquisition line spacing shall depend on the type of program being acquired and will meet the minimum requirements as set out by the MMS:

- Block Surveys (No Defined Location): in such surveys line spacing will be no greater than 150 meters in the primary direction with orthogonal tie lines at 300 m. Careful consideration shall be given to reducing line spacing in areas of known hazard complexity.
- Location or Drill Site Survey (Location Pre-Defined): in such surveys, line spacing will be no greater than 150 m in the primary direction with orthogonal tie lines at 300 m within 600 m or farther beyond the proposed well site, and a 300 meter primary direction with orthogonal tie lines at 600 m extending to a distance of 1,200 m from the surface location, and a 1,200 m in the primary direction with orthogonal tie lines at 1,200 m beyond that limit to a total of 2,400 m from the well site.

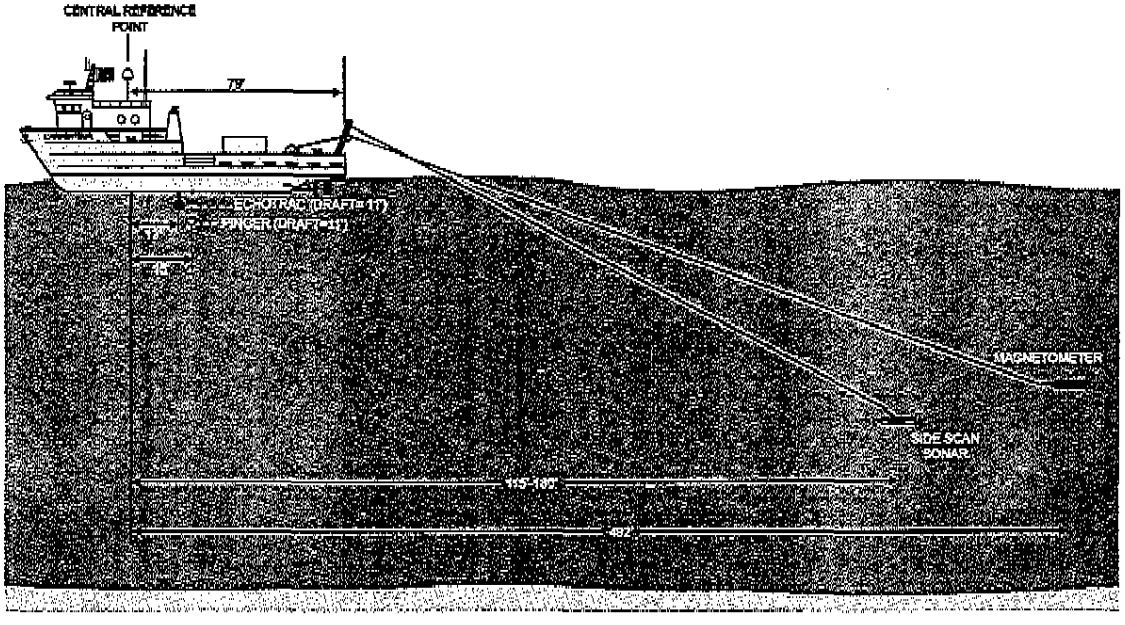
Data interpretation and Final Site Assessment Reporting

For site clearance investigations, a sound geologic interpretation of all the data is needed for the engineering geologist to assess site conditions properly. The data interpretation and site assessment phase of a site study should provide the user with as much information as possible about seafloor topography and geologic conditions of engineering importance. The

information is presented in a useful format and in terminology appropriate to the user, who is often a geotechnical engineer, a structural engineer, drilling engineer, regulatory engineer, or federal / state / local regulatory agencies staff member.

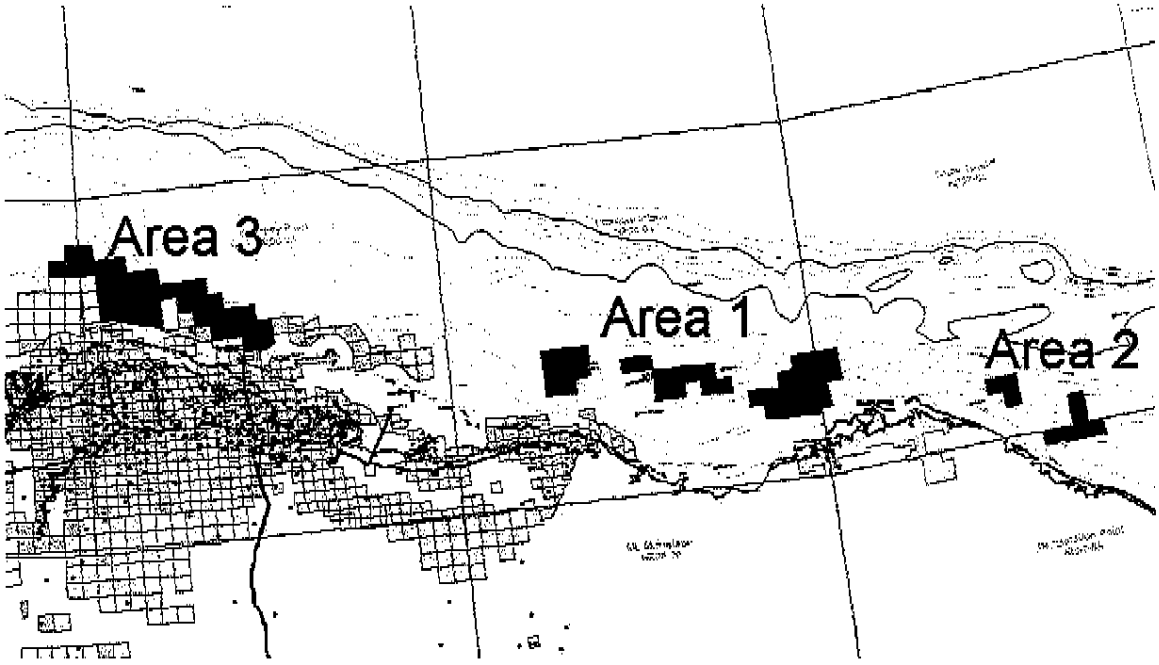
The final interpretative report will be prepared detailing the notable geological and geophysical features and their potential effect upon a subsea oil and gas development. This report will meet or exceed the MMS requirements for site assessment reporting.

Typical Configuration of Site Survey Vessel

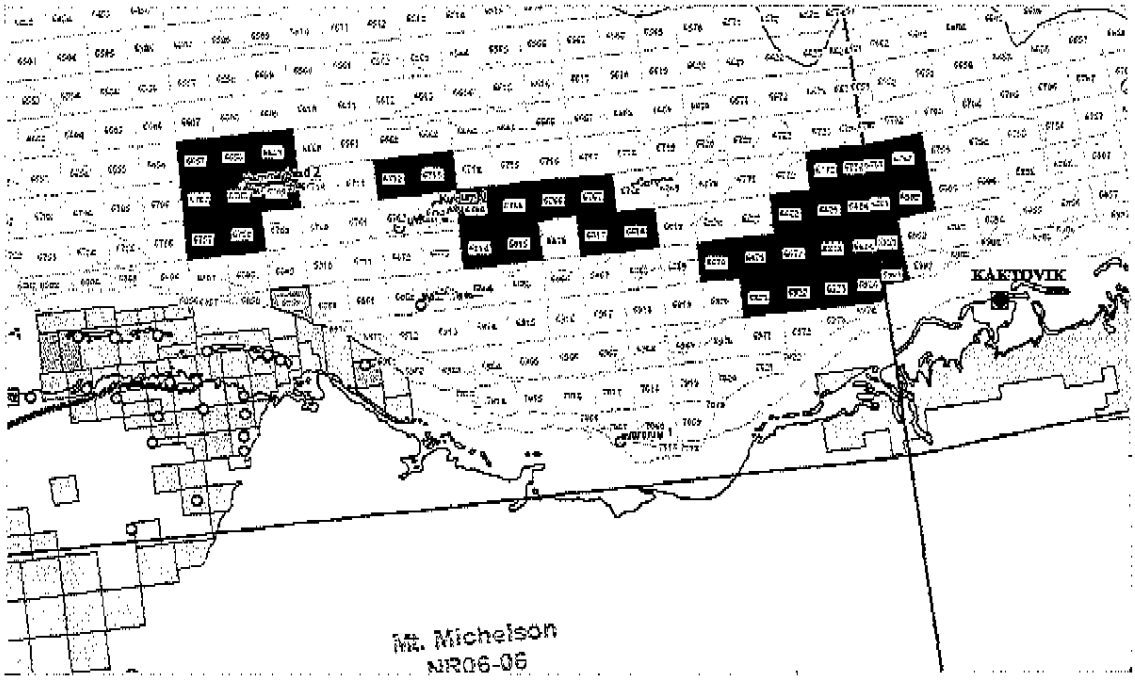


Survey Areas: Vicinity Map

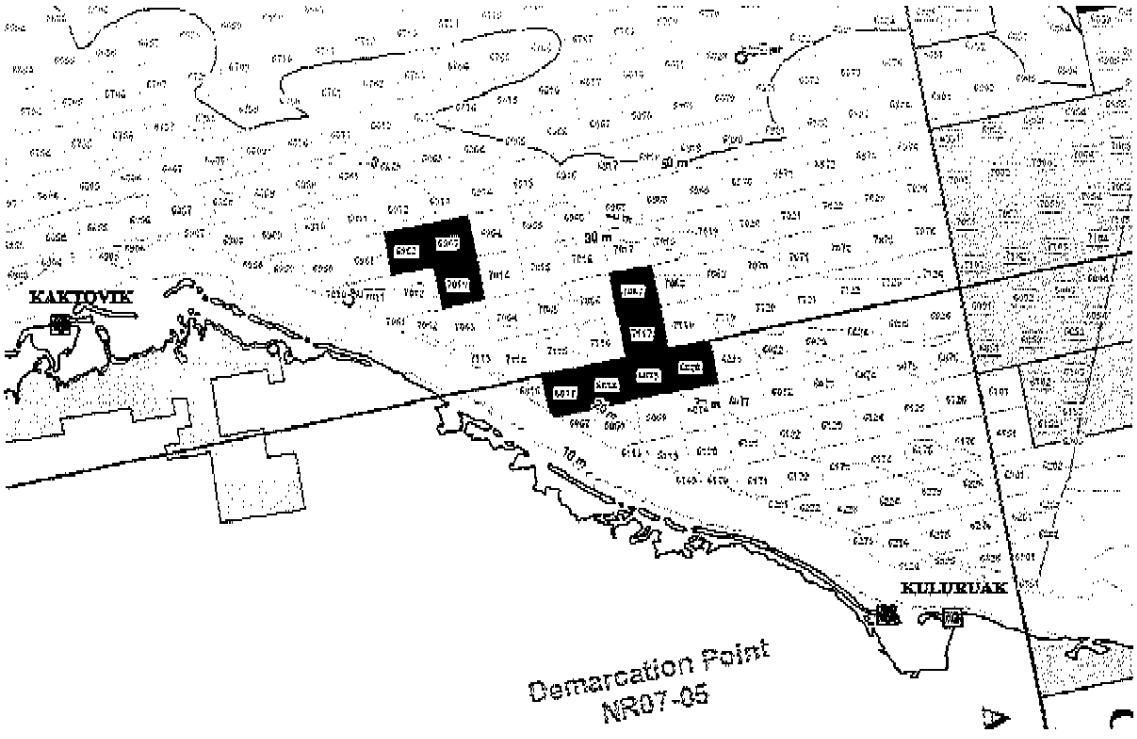
Site Survey areas within three focus areas will be defined.



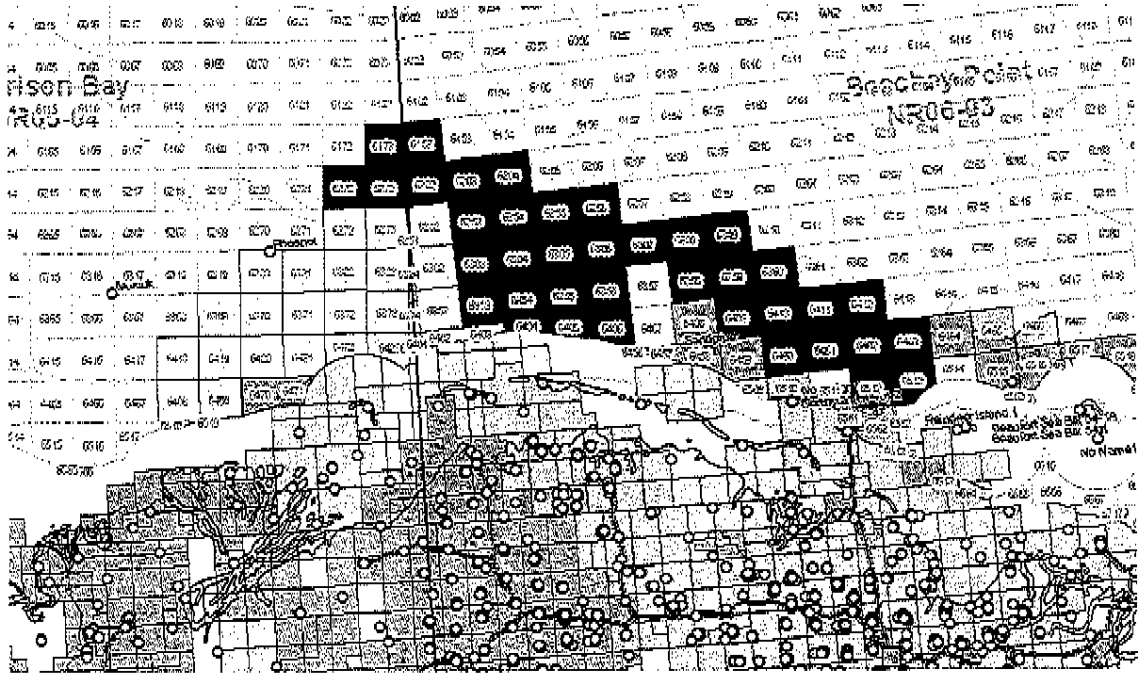
Area 1



Area 2:


KAKTOVIK
KUKURUAK
Demarcation Point
NR07-05

Area 3:


Beechey Point
NR06-03